NAVSHIPS-351-0461

Instruction Book

MAIN BOILERS

DL4 and DL5

DD927/G&C - 14

U. S. Navy Contract NOBS-2664

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CONTENTS

CONTENTS

CHAPTER 3 — MAINTENANCE (Cont'd)

CONTENTS

CHAPTER 3 — MAINTENANCE (Cont'd)

CONTENTS

(2) If the fire and bilge pump is located in the fireroom, use it to pump the contents overboard, taking suction from the bottom blowdown line.

(3) Flood the bilges with water to a depth of approximately 12 in.; then drain the steam generator to the bilges through the bottom blowdown line. As soon as the contents have been drained, pump the bilges dry, wash them out, and again pump them dry.

After the contents of the boiler have been discharged by one of the three methods, wash all parts of the boiler thoroughly with a high pressure water hose, also flush all lines through which the compound has passed.

5—**Inspection**—Because of the possible presence of inflammable or noxious vapors in the steam generator, it is extremely important to ventilate the unit thoroughly before entering for inspection of pressure parts. ***It is also important to make sure, before entering the unit, that all valves which might permit the entrance of steam or water into the unit are tagged, closed, and secured by a lock or wiring.***

Make a thorough inspection of the internal surfaces and, if any scum or oil is present, repeat the boiling-out procedure. It is advisable to run a rag on a rod through various tubes to determine their condition. Black smudge may be found at the ends of a tube in a new steam generator even though the remainder of the tube may be clean. A slight trace of this black deposit is not harmful and it may be wiped out with a rag which has been moistened with a non-oil, non-poisonous cleaning fluid; however, if the black smudge is greasy or if any other oil or grease is found, it will be necessary to boil out the pressure parts again.

PUTTING STEAM GENERATOR IN SERVICE

Section 4

1—**General**—Before putting the steam generator in service, refer to the instructions under "Hydrostatic Test", "Drying Out Refractory and Boiling Out Pressure Parts", and "Operating Precautions".

2—**Internal and External Inspection**—Before inspecting the steam generator, blow out the furnace with air or steam to remove any inflammable or noxious vapors. If neither air nor steam is available, thoroughly ventilate the furnace.

Make sure that:

All internal parts of the steam generator and piping are clean and free from any obstructions or foreign matter.

The soot blowers are located properly and alignment is such that there is no possibility of steam cutting the boiler tubes.

The furnace and all gas and air passages are free and clear.

All dampers and fan control mechanisms work correctly and indicators show correct positions.

Gage glass drains work properly and are closed.

Safety valves have been put in proper operating order after hydrostatic test.

3—**Valves and Openings**—After the above inspection has been carried out:

Close the manholes and see that all hand-holes are plugged.

Close fireside, inspection doors, burner registers, etc.

Open water gage valves.

Close surface and bottom blow valves.

Close waterwall header drain valves.

Open steam drum vent valve.

Open the superheater vent and drain valves and desuperheater drain valves.

4—**Filling Boiler**—Fill the boiler with the best available feedwater to normal water level.

If the steam generator has been standing idle with the pressure parts filled with water, drain the boiler through the bottom blowdown line until the water level is just below the bottom of the lower gage glass; then drain the superheater and leave the superheater drain valves open to the bilge. Make sure that the water gage inlet valves, the steam drum and superheater pressure gage valves, and the steam drum vent valve are open; then raise the water level to normal, checking to see that the feedwater system is functioning properly.

5—**Starting Operation**—After referring to the fuel oil burner instructions under "Maintenance", Section 7 page 33 make sure that the smallest

available sprayer plate is installed in the atomizer of each burner; then start intermittent firing and rotate burners using only one burner at a time. The sequence of lighting off is shown by the numbers in Fig. 13.

For Superheater Protection, when starting up the following instructions must be observed: (a) Before lighting the first burner, open desuperheater discharge to auxiliary exhaust line and open steam connection from the 300 lb. line to admit protection steam to superheater inlet. It is essential that steam flow thru the superheater be maintained at all times. (b) Close protection steam connection to superheater inlet when steam drum pressure reaches 150 lb. per sq. in. gage and in any case by the time the steam drum pressure equals the pressure in the auxiliary steam line.

When steam issues forcibly from the steam drum vent, close the vent valve.

Blow the pressure gage lines to see that the gages are operating satisfactorily, and operate the water gage drain valves to see that these gages are functioning properly.

Cutting in—(a) When boiler pressure is 5 to 10 lb. per sq. in. above the line pressure, crack the superheater outlet valve. Allow pressure to equalize, then slowly open the superheater outlet valve wide open. The boiler is cut in on the auxiliary line in a similar manner.

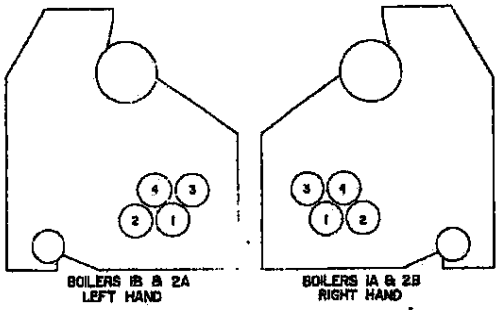

FIGURE 13. ARRANGEMENT OF TODD FUEL OIL BURNER SHOWING BY NUMBERS THE ORDER OF LIGHTING-OFF THE ATOMIZERS.

(b) When the superheater outlet valve has been opened wide, secure the discharge connection to the auxiliary exhaust line.

It should be noted that water level may rise as boiler pressure is brought to line pressure. Do not allow it to pass out of the top of the upper glass nor blow it down beyond the normal water level.

If steam should be formed in economizer, as indicated by water-hammer, increase feed to clear economizer and blow down boiler to remove excess water.

Adjust feed of water and fuel to get output desired, doing it as gradually as possible.

The feedwater regulator installed is Swartwout FW6 two element impulse feed water regulator.

When starting up, feedwater is controlled by hand from J6 Selector panel shown in Fig. 33, page 46. After the boiler is on the line and on a fixed load, switch from manual to automatic control. Instructions for making this transfer are given on page 47, Section 8, paragraph 4-C.

In the case of new boilers, operation should be limited to low loads for a few days.

6—**Caution**—To prevent spalling and erosion of the refractory and to hold down the temperature at the superheater until normal feed and steam flow are established, *it is recommended that at least three hours be taken to put the steam generator in service.* However, in cases of extreme necessity, the unit may be put in service more rapidly.

OPERATING PROCEDURE

Section 5

1—**General**—To insure efficient operation and to eliminate excessive maintenance, it is important to comply at all times with the instructions under "Operating Procedure" as well as those under "Operating Precautions".

2—**Fuel Oil Burners**—Keep a careful check on the atomizer tips and burner throats to see that they are free of dirt and carbon deposits and are functioning properly (see fuel oil burner instructions under "Maintenance"). Clean the atomizers at least once every 8 hours, and more often if necessary, to insure proper combustion and thereby hold soot deposits to a minimum. Sprayer plates of different sizes are required for different

ranges of operation and it is important to see that sprayer plates of the proper size are installed in the atomizer tips at all times, especially when the fires are low. *Do not fire with mixed tips.*

3—**Safety Valves**—Lift the steam drum and superheater safety valves by hand at least once a week to insure that they are functioning properly.

4—**Soot Blowers**—While under way, operate the soot blowers at least twice each day at intervals of as nearly 12 hours as practicable; while at anchor, operate them at least once each day. When practical, blow tubes just after the making of heavy smoke from any cause (lighting off, smoke screens, etc.) When blowing, operate only one unit at a time, and be sure the valve in the operating head is closed before starting to blow the next unit. When all units have been operated, close steam supply valve, open the drain valve and return the forced draft air to normal pressure.

For the order of blowing see Fig. 13-A. For operating instructions see Vulcan Soot Blowers. Section 9, page 69.

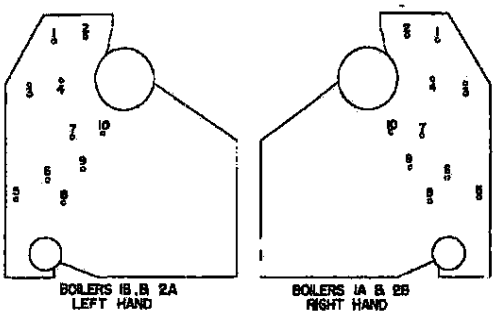

FIGURE 13A. Arrangement of Vulcan Soot Blowers, Showing by Numbers the Order of Blowing.

5—**Leakage**—Inspect the casings for leakage and, if necessary, make them air tight. Inspect the pressure parts at frequent intervals for leakage. If a steam or water leak is found, take the steam generator out of service and make the necessary repairs.

Caution—Do not attempt to repair pressure parts while the steam generator is in operation. However, in emergency a leak in a handhole plug may be stopped with boiler in service. See instructions "Emergency Repair of Handhole Plugs" under Maintenance Chapter 3 Section 5, Paragraph 9-D page 30.

7—**Soot Deposits and Incrusting Formations**—Keep all parts of the steam generator free of soot deposits, which set up corrosion if they become damp. Corrosion may also be set up by an incrusting formation resulting from a leak; therefore, it is important to remove the formation and stop the leak.

OPERATING PRECAUTIONS

Section 6

1—**Blowdown Valves**—When operating either the surface or bottom blowdown valve, open it wide and operate it quickly while opening or closing it. The bottom blowdown valve is used either to reduce the concentration of solids in the boiler water or to empty the boiler for inspection. *Operate this valve only when all burners are shut down,* and do not use it to lower high water level.

The surface blowdown valve is used either to clear any scum, oil, or grease from the surface of the boiler water or to lower abnormally high water level.

Side and rear waterwall headers, also water screen headers, on newly commissioned vessels should be blown down when securing the boiler after each period of steaming, until the first regular boiler cleaning period. Thereafter, blow-down shall be made at regular intervals as found necessary, but intervals shall not exceed 200 steaming hours. These headers shall *never be blown down until after all burners on the boiler have been secured.*

2—**Feedwater**—Keep all feedwater tanks free of oil and clean them as often as necessary to prevent an undesirable accumulation of sediment or other foreign matter in the tanks. Be very careful not to permit oil, especially that containing vegetable fats, to enter the boiler as it is apt to collect in clots or films on heating surfaces and this may cause overheating with resultant blistering and eventual rupture of the affected tubes.

Use preheated, distilled, and deaerated feedwater.

Feedwater for these boilers shall be treated in accordance with methods and procedures designated by the Bureau of Ships.

To prevent possible excessive carryover of solids, operate the bottom blowdown valve as

often as necessary to keep the concentration of solids in the boiler water below the limitation set by the Bureau of Ships. *Cut out burners first.*

Do not allow sudden feeding of cold water into a hot boiler, except in cases of extreme emergency, as the resultant sudden cooling of the pressure parts might cause serious leakage at rolled joints and thereby necessitate extensive repair.

3—**Fuel Oil Leakage**—Frequent observation should be made of part of the air casing to detect accumulation of oil by means of the light and periscope provided.

By revolving the periscope and switching on the light provided, the section inside the outer casing in which any oil resulting from leakage would accumulate is visible. The periscope and light are located in the access door on the boiler front.

4—**Water in Fuel Oil**—The presence of a considerable amount of water in the fuel oil is indicated by sputtering atomizers. In this case follow instruction given in the Bureau of Ships Manual, Chapter 51, Boilers.

5—**Combustion**—Since the admission of either too much or too little air to the furnace would result in inefficient operation, it is important to regulate the burner air so that just enough is admitted to insure complete combustion of the fuel.

The smoke indicator will show whether the fuel/air ratio is correct for efficient combustion (see smoke indicator instructions under "Maintenance").

After the operator has become familiar with the operation of a particular steam generator and providing the heating surfaces of the steam generator are clean, he will be able to judge whether the fuel/air ratio is correct by observing the steam temperature at the superheater outlet. Too high a steam temperature indicates that too much air is being admitted and too low a steam temperature indicates that too little air is being admitted.

6—**Furnace Temperature**—Never allow sudden wide changes in furnace temperature since spalling and erosion of the refractory and consequent excessive refractory maintenance are occasioned by quick heating or cooling of the refractory. When putting a steam generator in service, heat the refractory slowly; when removing a steam generator from service, close each burner air register as soon as the burner is secured and keep all accesses to the furnace closed so that the refractory will cool gradually.

7—**Water Level**—The normal water level is usually between the center of the steam drum and 1" below the center. The level should be held as closely to this point as possible. It is important never to allow the level to go above the top of the upper gage glass since priming, which is the undesirable presence of water or moisture in the steam leaving the steam drum, may result. To keep the level from rising too high, shut off the feedwater and, in cases of emergency, open the surface blowdown valve.

Low water is the most dangerous condition frequently experienced in the operation of steam generators, and is generally due to inattention on the part of the operators. If the loss is gradual and noticed by the operators:

(a) Increase the rate of feed.

(b) Check feed line for leaks or open valves.

(c) Check blow valves for leaks or opened valves.

(d) Check auxiliaries for water in steam from auxiliary steam line which indicates leakage from boiler steam drum into desuperheater.

(e) Start auxiliary feed system.

If, *at any time,* the water level falls out of sight in gage glass *secure all burners immediately.*

8—**Tube Failure**—If a tube failure occurs, secure the burners immediately and, if possible, increase the rate of feed enough to bring the water level back to normal; then, insofar as possible, comply with the instructions under "Taking Steam Generator Out of Service".

Note—*Watch water level in other boilers.*

Caution—In case of tube failure do not open the bottom blowdown unless escaping steam seriously endangers personnel. If this is the case, then close the feed stop valve and dump the boiler through the bottom blowdown line. Keep the draft fan running and the burner air registers open to force escaping steam up the stack.

TAKING STEAM GENERATOR OUT OF SERVICE

Section 7

1—**Soot Blowers**—Just before taking the steam generator out of service, operate the soot blowers if practicable (see the soot blower instructions under "Maintenance", page 69).

2—**Oil Burners**—Close the oil valves to the atomizers, one by one, at the same time closing the air registers. Slow down the oil service pump as the atomizers are shut off to prevent the pressure from building up. Slow down the blowers. When all atomizers are closed, secure the oil lines and fuel pumps. Directly after shutting down a burner, remove the atomizer, drain it, and immerse the tip in kerosene. Run a blower long enough after shutting off oil supply to insure that all oil on the furnace floor is consumed and that the furnace is cleared of all gases. Comply with the fuel oil burner instructions under "Maintenance" Chapter 3 Section 7 page 33.

Except in cases of emergency, keep all accesses to the furnace tightly closed to prevent quick cooling and consequent spalling and erosion of the refractory. In some cases, a very slight cracking of the air registers may be permitted to prevent overheating of burner parts subjected to furnace temperature.

3—**Feedwater**—Regulate the feedwater to maintain the normal water level in the drum.

4—**Boiler Pressure** — When boiler pressure drops below normal working pressure, start closing the main stop valve.

Note—If the shutdown has been necessitated by a tube failure or some other emergency, the main stop valve may be closed at once.

Caution—*It is of the utmost importance that drain on the superheater outlet header be kept open to assure a flow of steam through the superheater elements.*

5—**Disposition**—After the steam generator has cooled to room temperature, inspect it or lay it up as directed under "Inspection" or "Laying Up Steam Generator".

INSPECTION

Section 8

1—**General**—If an inspection is to be made when the steam generator has just been taken out of service, it will first be necessary to drain the pressure parts. Before entering the steam generator, blow out the furnace with air or steam or ventilate it thoroughly to remove any inflammable or noxious vapors which may be present. *Make sure, before entering the steam generator, that all valves which might permit the entrance of steam or water into the unit are tagged, closed, and secured by a lock or wiring.* After the inspection has been completed, make sure that any necessary repairs are properly made. See Ch. 3 Maintenance, Internal and External Inspection, Section 4 page 26.

LAYING UP STEAM GENERATOR

Section 9

1—**Short Term Procedure**—If it is expected that a steam generator will be out of service for a few days, protect it against corrosion by filling the boiler, economizer and superheater, with feedwater which has an alkalinity as specified in Chapter 56 of Bureau of Ships Manual. See that water gage inlet valves and pressure gage valves are open, and make sure that all drain valves are closed.

Caution—Do not let a steam generator which is not in service stand partially filled with water for several days.

2—**Long Term Procedure**—If it is expected that a steam generator will be out of service for a prolonged period, drain it as completely as possible, being particularly careful to blow or otherwise remove all water from such places in drum, tubes, superheater or economizer headers or elements which may not be completely self-draining. Take "list" of the vessel into consideration. To protect the steam generator against corrosion, place a number of shallow pans, partially filled with a dehydrating agent such as quicklime or calcium chloride in the steam and water drums. Distribute the dehydrating agent in the pans to expose as much surface as possible so that the maximum amount of moisture will be absorbed from the air in the boiler. Close the manhole plates and all valves to make the boiler as nearly air tight as possible. Replace the dehydrating agent every 3 to 6 months or when it has absorbed enough moisture to make it ineffective.